DIGITAL RAIN GAUGE

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Dedicated to my beloved
Father, Mother and my Family,
My Supervisor, staff &
My Friends

Million of thanks for all the Assist,
Supporting and Encouragement

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ABSTRACT

Rain fall is nature phenomena that occur that give humidity on the ground. Too much humidity cause flood on the ground and if the humidity is small, the ground is dry. The rain gauge is the equipment that used by people in weather station to measure cumulative rain fall at a given location and given time. Rain gauge also known as udometer or pluviometer consist main part can to collect water fall from funnel above it, and outer case to protect the inner can. The new design of rain gauge give more accurate reading now day and have many other advantage such as observer can observe the rain fall from far, the measure of rain fall is according tip drop not only looking at the water level anymore where is sometimes cause error, the digital reading can be taken and many more. Tipping Bucket Rain Gauge is the new device that has all the advantage of the criteria above. This rain gauge is using two small bucket acting like see-saw, when one of the buckets is fill with water it will spill because of the unbalance see-saw. Then the other bucket will fill the water and repeat the same action like the first bucket and keep repeating until the rain stop. With the combination of the Microcontroller, sensor and LCD, digital rain gauge is build.

ABSTRAK

Hujan adalah fenomena semulajadi cuaca yang memberikan kelembapan pada tanah. Jika kelembapan tanah tinggi ia boleh menyebabkan banjir dan jika kelembapan tanah kurang atau sedikit maka kawasan itu adalah kering. Tolok hujan adalah alat yang digunakan di stesen pengkaji cuaca untuk mengukur timbunan hujan di sesetengah kawasan pada sesuatu masa. Tolok hujan juga dikenali sebagai Udometer atau Pluviometer mengandungi 3 bahagian iaitu bekas luar, yang melindungi bekas dalam berbentuk silinder dan corong yang mengumpul air hujan di bahagian teratas tolok hujan. Reka bentuk tolok hujan yang baru memberikan bacaan yang lebih tepat dan mempunyai banyak kelebihan antaranya pemerhati boleh mengambil bacaan jauh dari tolok hujan ketika hujan, bacaan air hujan di kira melalui titisan air yang melalui corong bukan lagi dengan membaca di selinder penyukat yang boleh menyebabkan ralat, bacaan digital boleh dilihat dan lain-lain lagi. Tolok hujan titisan timba adalah alat sukatan hujan yang terbaru dan memenuhi setiap kelebihan tersebut. Tolok hujan ini mempunyai 2 timba yang bertindak seperti jongkang-jongkit, apabila satu daripada timba dipenuhi air maka ia menjadi tidak stabil dan mengalirkan air keluar dan satu lagi timba akan dipenuhi air menyebabkan proses tersebut berulang sehingga hujan berhenti. Dengan kombinasi Pengawal-mikro, alat pengesan dan LCD maka terhasillah tolok hujan digital.

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PIC	-	Peripheral interface controller
LCD	-	Liquid Crystal Display
mL	-	mililitre
mm	-	millimeter

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Malaysia is the one of the country on the equator and have tropical climate in this world. This country having heavy rain fall in every year even when in dry season there still cloud at the sky. For the state on east cost of Malaysia, November until January constitute the month for maximum rain fall and for June till July is the most dry season among all the state in Malaysia. To measure the rain fall, one device is used that is digital rain gauge where the measurement is accurate and readable.

Common rain gauge only consist three main part funnel, inner can and outer can. Rain fall is collected by the funnel and flow the water into inner can, after rain stop meteorologist will take the reading by looking at the inner can scale. Then other version of rain gauge came up where each drop of rain is counted and recorded. The tipping bucket rain gauge solve the problem but the design is used many mechanical part to record the data. The recorder consists of a pen mounted on an arm attached to a geared wheel that moves once with each signal sent from the collector. At the top of the

cylinder is a funnel that collects and channels the precipitation. The precipitation falls onto one of two small buckets or levers which are balanced in same manner as a scale or seesaw. After an amount of precipitation equal to 0.5 mm falls the lever tips and an electrical signal is sent to the recorder.

1.2 Objective of Project

i) To built Tipping Bucket Rain Gauge with digital display
   (a) Tipping bucket rain gauge is constructed with several can, funnel and two bucket that balance each other. The material to build the tipping bucket rain gauge mostly is plastic.

ii) Measure the water level of rainfall with precise reading
   (a) The tipping bucket is design and setting to measure the rain fall in more accurate way. Every tip drop of the water must be measure small enough to make sure the counter in small percentage.

iii) To understand and study about Microcontroller (PIC)
   (a) The project is involving the microcontroller and basically this will indirectly introduce the function and the programming of Peripheral Interface Controller (PIC). In this project the involve PIC16F84A.

1.3 Scope of Project

Work scope in this project can be dividing by 2:

1.3.1 Hardware:

i. Designing the circuit using Microprocessor (PIC 16F84A) and sensor reed switch. The circuit designs also provide display using Liquid Crystal Display (LCD).

ii. Produce the model of tipping bucket rain gauge with standard measurement stand with outer can, inner can, funnel and tipping bucket.

1.3.2 Software:

i. The program for the PIC is constructed by using BASIC language that can be done in Microcode Studio Software. The instruction basically assign input from the sensor as 1 input and each input trigger as 0.2ml then it will display in the LCD.

1.4 Problem Statement

The tipping bucket rain gauge with digital display is one good alternative way to measure rain fall rather than conventional rain gauge where Meteorologists need to wait until rain to stop then take the reading. While waiting rain to stop some of the rain precipitation will vaporise and make the reading not accurate. The advantage of the tipping bucket rain gauge is that the character of the rain (light, medium or heavy) may be easily obtained. Rainfall character is decided by the total amount of rain that has fallen in a set period (usually 1 hour) and by counting the number of 'clicks' in a 10 minute period the observer can decide the character of the rain. [1]

Although the tipping bucket rain gauge has many advantages, tipping bucket rain gauge is not as accurate as the standard rain gauge because the rainfall may stop before the lever has tipped. The ground must be level and must be mounted on a vibration-free level surface to make sure the lever didn’t tip before it should be.

The accuracy to take the measurement of rain fall is the most important part in building rain gauge model. So, the design and the details of the bucket and all the part of the rain gauge is the main priority. But this project is only considered in building the model, not to really measure rain fall because when measuring the rain fall we need to plot the average rain in month.

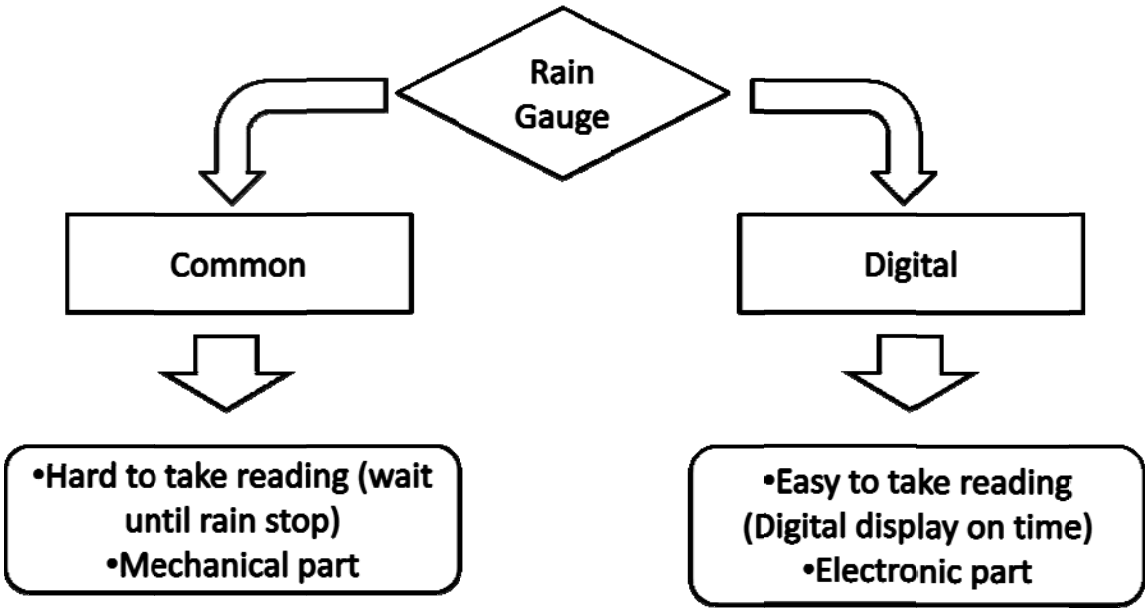

Figure 1.1: Problem Statement Summary

CHAPTER 2

THEORY AND LITERATURE REVIEW

2.1 Introduction

There is many version and design of rain gauge use to measure rain fall. Most of the design of the rain gauge is particularly about the same. In designing tipping bucket rain gauge there is a lot of part and component involve. In this chapter the theory of every mechanical part of the model and the circuit will be discuss.

2.2 Rain gauge

There is many type of rain gauge use nowadays. The different in design and function is optional but still the main purpose to build rain gauge is to measure the cumulative rain fall over certain area in certain time.

2.2.1 Standard Rain Gauge

The standard rain gauge consists of a funnel attached to a graduated cylinder that fits into a larger container. It consists of a 5" diameter funnel with a sharp rim, the spout of the funnel being inserted into a glass collecting jar. The jar is in an inner copper can and the two are contained in the main body of the gauge, the lower part of which is sunk into the ground. The diagram shows the whole gauge arrangement. [2]

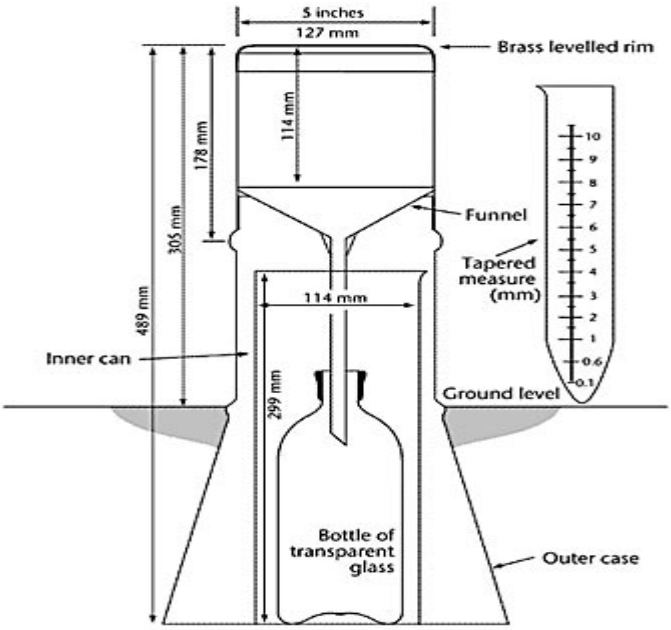

Figure 2.1: Standard Rain Gauge

2.2.2 Weighing Precipitation Gauge

A weighing-type precipitation gauge consists of a storage bin, which is weighed to record the mass. Certain models measure the mass using a pen on a rotating drum, or by using a vibrating wire attached to a data logger. The advantages of this type of gauge

to tipping buckets is that it does not underestimate intense rain, and it can measure other forms of precipitation, including rain, hail and snow. However, these gauges are more expensive and require more maintenance than tipping bucket gauges. The weighing-type recording gauge also contains a device to measure the quantity of chemicals contained in the locations atmosphere. This is extremely helpful for scientists studying the effects of greenhouse gases released into the atmosphere and their effects on the levels of the acid rain. [1]

2.2.3 Optical Rain Gauge

These have a row of collection funnels. In an enclosed space below each is a laser diode and a phototransistor detector. When enough water is collected to make a single drop, it drips from the bottom, falling into the laser beam path. The sensor is set at right angles to the laser so that enough light is scattered to be detected as a sudden flash of light. The flashes from these photodetectors are then read and transmitted or recorded. Digital rain gauge is most expensive among of all the rain gauge because it provide with new technology equipment. [1]